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# FERTILIZER AND LIME APPLICATION ON FARMS, 1954

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U. S. DEPARTMENT OF AGRICULTURE

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## SUMMARY

In 1954, the job of applying solid fertilizer was done largely by farmers with their own, borrowed, or exchange equipment, whereas custom operators applied nearly half of all liquid fertilizer and most of the liming materials. Row-crop equipment accounted for about 40 percent of the placement of solid fertilizer, broadcast spreaders for 27 percent, and attachments on grain drills for 18 percent. Bulk spreading of fertilizer by custom operators with motortruck spreaders was important in some States.

In the calendar year 1954, more than 40 million tons of fertilizer and liming materials were sold or shipped for use in continental United States.

Production of commercial mixed fertilizer in this country began on a small scale around 1850. For many years use of fertilizer was concentrated in States east of the Mississippi River. In recent years, however, consumption has become more widespread. In 1954, the average quantity used per acre of cropland (including cropland not fertilized) ranged from 3 pounds in South Dakota to 1,132 pounds in Florida. Farmers use liming materials to a much greater extent now than they did 20 years ago, but the quantity used in 1954 was more than a third less than that used in 1947.

## THE BACKGROUND

This report contains information on methods of applying fertilizer and liming materials in 1954 and trends in the use of these materials. The information concerning methods of applying fertilizer and liming materials was supplied by the voluntary crop reporters of the United States Department of Agriculture in February 1955. A mailed questionnaire was used and about 28,000 usable schedules were returned.

The data for 1954 included the quantity of solid and liquid fertilizer and liming materials applied on the reporters' farms. The information reported for solid fertilizer included the quantity applied by these farmers on their own land and that applied by custom operators. A further breakdown showed the quantity applied with attachments on row-crop planters, grain drills, and cultivators; with motortruck and broadcast spreaders; with row-crop distributors; by hand; and by all other methods. Anhydrous ammonia and other liquid fertilizers were reported in the quantities applied by the farmers with soil injectors using their own labor and power, and by custom operators. The quantity applied by all other methods was reported also. The quantity of liming material applied by the farmers with their own, borrowed, or exchange equipment and the quantity applied by custom operators were reported. The estimated tonnage was used to determine the percentage of the material applied by different methods.

The data were tabulated and summarized by seven size-of-farm groups within each State. These data were weighted by the number of farms in each group from the November 1954 Census of Agriculture to derive State estimates. This procedure is believed to have eliminated a substantial part of the bias that arose because the farms in the survey were above average in size. Even so, the estimates can be considered only as approximations.

The data in this report concerning total quantities and kinds of fertilizer were supplied by the Soil and Water Conservation Research Division, Agricultural Research Service. The data showing annual sales of liming materials for recent years were taken from reports of the National Agricultural Limestone Institute, Inc.

## SOLID FERTILIZER

Most of the fertilizer applied in 1954 was purchased in solid form. Farmers applied 90 percent of this fertilizer to their land with their own, borrowed, or exchange equipment (table 1). The rest was applied by custom operators mainly with motortruck spreaders. The importance of this method varied by States. Farmers in Illinois hired 33 percent of their solid fertilizer applied. Other States in which custom operators applied large quantities were Iowa, 24 percent, and California and Florida each, 22 percent.

Row-crop equipment was used to apply about 40 percent of the solid fertilizer in 1954. Around 30 percent was applied with attachments on row-crop planters, 7 percent with row-crop distributors, and 5 percent with attachments on cultivators. With planter-attachment application, the planting and part or all of the fertilizing are done in one operation. Later, side dressing is sometimes done with cultivator attachments. Above-average percentages of the application with planter attachments were reported in areas where corn, cotton, and some truck crops are grown extensively. Many of the States in the Southeast, Lake, and Corn Belt groups ranked high in percentage of fertilizer applied in this way. In Georgia and Alabama, nearly half of the solid fertilizer was applied by this method.

Table 1.- Solid fertilizer: Quantity applied and methods of application by States and Areas, 1954

| Area and State | Quantity | | | Methods of application | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Attachments on - | | | Spreaders | | | | |
| | Total 1/ | By custom operator | By farmer | Row crop planters | Grain drills | Cultivators | Motor-truck | Broadcast | Row crop distributors | Hand | Other methods |
| | 1,000 tons | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| Northeast: | | | | | | | | | | | |
| New England---- | 424 | 5 | 95 | 33 | 3 | 2 | 4 | 48 | 2 | 4 | 4 |
| New York------- | 603 | 5 | 95 | 30 | 42 | 3 | 5 | 11 | 1 | 3 | 5 |
| New Jersey----- | 286 | 12 | 88 | 25 | 12 | 14 | 10 | 30 | 5 | 3 | 1 |
| Pennsylvania--- | 705 | 7 | 93 | 30 | 45 | 2 | 6 | 12 | 1 | 2 | 2 |
| Delaware------- | 93 | 15 | 85 | 26 | 25 | 10 | 15 | 17 | 5 | 1 | 1 |
| Maryland------- | 311 | 12 | 88 | 26 | 35 | 5 | 10 | 19 | 3 | 1 | 1 |
| Total-------- | 2,422 | 7.7 | 92.3 | 29.3 | 30.9 | 4.4 | 6.7 | 21.3 | 2.1 | 2.5 | 2.8 |
| Corn Belt: | | | | | | | | | | | |
| Ohio----------- | 1,056 | 5 | 95 | 35 | 45 | 1 | 4 | 12 | 1 | 1 | 1 |
| Indiana-------- | 1,135 | 7 | 93 | 38 | 30 | 2 | 5 | 22 | 2 | 2/ | 1 |
| Illinois------- | 1,357 | 33 | 67 | 25 | 10 | 2 | 30 | 30 | 2 | 2/ | 1 |
| Iowa----------- | 604 | 24 | 76 | 30 | 5 | 4 | 22 | 30 | 5 | 2/ | 4 |
| Missouri------- | 744 | 14 | 86 | 22 | 35 | 2 | 15 | 20 | 4 | 1 | 1 |
| Total-------- | 4,896 | 16.9 | 83.1 | 30.3 | 25.4 | 2.0 | 15.3 | 22.7 | 2.5 | .4 | 1.4 |
| Lake States: | | | | | | | | | | | |
| Michigan------- | 604 | 4 | 96 | 26 | 50 | 3 | 4 | 13 | 1 | 2 | 1 |
| Wisconsin------ | 442 | 4 | 96 | 35 | 27 | 4 | 4 | 26 | 2 | 1 | 1 |
| Minnesota------ | 308 | 9 | 91 | 40 | 10 | 3 | 8 | 35 | 2 | 1 | 1 |
| Total-------- | 1,354 | 5.1 | 94.9 | 32.1 | 33.4 | 3.3 | 4.9 | 22.3 | 1.6 | 1.4 | 1.0 |
| Northern Plains-- | 460 | 5.0 | 95.0 | 12.0 | 42.0 | 4.9 | 4.0 | 33.0 | 3.0 | .1 | 1.0 |
| Appalachian: | | | | | | | | | | | |
| West Virginia-- | 74 | 4 | 96 | 20 | 24 | 1 | 4 | 30 | 5 | 15 | 1 |
| Kentucky------- | 582 | 3 | 97 | 25 | 15 | 3 | 2 | 40 | 8 | 6 | 1 |
| Tennessee------ | 564 | 3 | 97 | 31 | 28 | 2 | 2 | 27 | 4 | 6 | 2/ |
| Virginia------- | 799 | 14 | 86 | 18 | 23 | 7 | 12 | 27 | 7 | 6 | 2/ |
| North Carolina- | 1,858 | 2 | 98 | 38 | 16 | 10 | 2 | 12 | 17 | 5 | 2/ |
| Total-------- | 3,877 | 4.8 | 95.2 | 30.5 | 19.2 | 7.0 | 4.1 | 21.8 | 11.5 | 5.7 | .2 |

See footnotes at end of table.

- Continued -

Table 1.- Solid fertilizer: Quantity applied and methods of application by States and Areas, 1954-con.

| Area and State | Quantity | | | Methods of application | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Attachments on - | | | Spreaders | | | | |
| | Total 1/ | By custom operator | By farmer | Row crop planters | Grain drills | Cultivators | Motor-truck | Broadcast | Row crop distributors | Hand | Other methods |
| | 1,000 tons | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent | Percent |
| Southeast: | | | | | | | | | | | |
| South Carolina-- | 930 | 5 | 95 | 35 | 10 | 5 | 5 | 18 | 19 | 7 | 1 |
| Georgia--------- | 1,385 | 6 | 94 | 48 | 10 | 6 | 6 | 18 | 8 | 4 | 2/ |
| Florida--------- | 1,209 | 22 | 78 | 18 | 1 | 4 | 14 | 55 | 3 | 5 | 2/ |
| Alabama--------- | 1,259 | 10 | 90 | 46 | 4 | 6 | 10 | 19 | 7 | 7 | 1 |
| Total--------- | 4,783 | 10.9 | 89.1 | 37.4 | 6.1 | 5.3 | 8.9 | 27.6 | 8.6 | 5.6 | .5 |
| Delta States: | | | | | | | | | | | |
| Mississippi----- | 706 | 2 | 98 | 27 | 4 | 5 | 2 | 26 | 23 | 12 | 1 |
| Louisiana------- | 303 | 10 | 90 | 20 | 10 | 6 | 7 | 27 | 18 | 10 | 2 |
| Arkansas-------- | 366 | 4 | 96 | 24 | 12 | 5 | 4 | 29 | 17 | 7 | 2 |
| Total--------- | 1,375 | 4.3 | 95.7 | 24.7 | 7.5 | 5.2 | 3.6 | 27.0 | 20.3 | 10.2 | 1.5 |
| Southern Plains--- | 686 | 5.0 | 95.0 | 20.0 | 20.0 | 10.0 | 2.0 | 34.0 | 7.0 | 3.0 | 4.0 |
| Mountain---------- | 345 | 2.0 | 98.0 | 11.0 | 10.0 | 15.0 | 3.0 | 52.0 | 4.0 | 2.0 | 3.0 |
| Pacific: | | | | | | | | | | | |
| Washington------ | 167 | 5 | 95 | 4 | 7 | 2 | 3 | 74 | 3 | 2 | 5 |
| Oregon --------- | 141 | 3 | 97 | 10 | 4 | 2 | 2 | 68 | 6 | 6 | 2 |
| California------ | 1,414 | 22 | 78 | 7 | 4 | 10 | 15 | 43 | 6 | 10 | 5 |
| Total--------- | 1,722 | 18.8 | 81.2 | 6.9 | 4.3 | 8.6 | 12.8 | 48.0 | 5.7 | 8.9 | 4.8 |
| United States | 21,920 | 10.2 | 89.8 | 28.7 | 18.4 | 5.2 | 8.5 | 26.7 | 6.9 | 4.1 | 1.5 |

[1] Derived by deducting liquid fertilizer from total fertilizer tonnages. (3,000 tons used in the District of Columbia are not included.) Data from Soil and Water Conservation Research Division, ARS.

[2] Less than 0.5 percent.

States in the cotton and tobacco areas of the South reported important percentages of the fertilizer applied with row-crop distributors. In the Delta States, 20 percent was applied by this method; in South Carolina 19 percent; and in North Carolina 17 percent. In most of the other States in the country, the percentage of the tonnage of fertilizer applied in this way was relatively low.

Attachments on cultivators were used in applying about 15 percent of the total tonnage of fertilizer applied in the Mountain States and in New Jersey. Side dressing of truck crops in parts of these areas probably accounted for a large part of this tonnage.

Broadcast spreaders were used for 27 percent of the solid fertilizer applied in 1954. About half of the fertilizer in the Mountain and Pacific States was applied in this way, as was about a third in the Great Plains States. Spreaders other than motortruck spreaders were used to apply around three-fourths and two-thirds of the tonnage in Washington and Oregon, respectively.

Attachments on grain drills were used for 18 percent of the solid fertilizer placement. In areas in which most of the acreage of small grain is fertilized, important percentages of the total fertilizer were applied when the grain was drilled. In Michigan, Ohio, Pennsylvania, New York, and the Northern Plains, from 40 to 50 percent of all solid fertilizer was applied by this method. In the Pacific States and the Southeast, only about 5 percent of the fertilizer was applied with grain drills.

When motortruck spreaders were used, custom operators usually did the spreading. Often farmers can buy the fertilizer in bulk and have it spread for the same as, or less than, the cost of fertilizer alone when bought in bags. Illinois, which uses a great deal of raw rock phosphate, was the leading State in this respect. In this State, motortruck spreaders were used to apply 30 percent of all solid fertilizer. Important quantities were also applied in this way in Iowa, Missouri, California, Delaware, and Virginia. Gypsum and dried manures were used extensively in California. Much of the gypsum was applied with these spreaders but no information was given as to the methods used in applying dried manures.

Hand application of fertilizer was popular on small farms and in orchards. In West Virginia, 15 percent was applied in this way, in Mississippi, 12 percent, and in Louisiana and California, 10 percent.

A relatively small quantity of fertilizer was applied by methods other than those discussed. In the irrigated areas, some of the more soluble chemicals were applied along with irrigation water. Spreading fertilizer with manure by sprinkling it in gutters and on manure in the spreader, was done chiefly in the Northeast, but some fertilizer was spread with manure in most areas of the country.

Fertilizer was applied with plow sole attachments chiefly in the Corn Belt and the Northern Plains. Wheatland plow attachments were reported in California and Montana.

The use of airplanes for spreading fertilizer is increasing in some areas. This method accounted for important quantities of the fertilizer spread, especially on the larger farms and ranches, in California, Oregon, Washington, Texas, Idaho, Louisiana, and Arkansas.

Some application of fertilizer with seeders was reported in most areas of the country. No information was given as to the kind of fertilizer applied by this method.

## LIQUID FERTILIZER

Around 1940 equipment was being developed for injecting anhydrous ammonia vapor deep enough into moist soil to combine with the moisture and prevent its escape. In 1954, liquid fertilizers applied with soil injectors by custom operators ranged from 19 percent of the total in the Delta States to 71 percent in the Northern Plains (table 2). Most of the liquid fertilizer not applied with injectors was put on their own land by the farmers. This was done through irrigation water, with sprayers, in transplanting water, with cultivator attachments, and by spraying on seed.

Spray was applied in several ways. Fertilizers were mixed with pesticides and applied as foliants; spray was applied with field-type sprayers and by airplanes; and small quantities were put on with hand sprayers.

Consumption of fertilizer in liquid form has increased rapidly in recent years. In the calendar year 1954, the use of anhydrous ammonia, aqua ammonia, nitrogen solutions, liquid mixtures, and phosphoric and sulphuric acids, amounted to about 600,000 tons.

In 1954, around 80 percent of all the liquid fertilizer was used in the Western, Delta, and Corn Belt States. Anhydrous ammonia accounted for most of the liquid fertilizer used in the Delta States and for 72 percent of that used in the Corn Belt. The quantity of anhydrous ammonia used in the Western States amounted only to 30 percent of all liquid fertilizer used.

## TRENDS IN CONSUMPTION OF FERTILIZER

Beginning with 1850, consumption of fertilizer about doubled with each succeeding decade until 1910 (table 3). During World War I, production of fertilizer was curtailed because of acute shortage of materials, especially potash. In the early years of the 1920's and the depression years of the 1930's, demand for fertilizer was greatly reduced. The consumption in 1932 was lower than for any year since 1905. Except in 1938, consumption of fertilizer has increased since 1932. By 1954, sales of all fertilizers amounted to 22.5 million tons. The tonnage figures include fertilizer for

Table 2.- Commercial liquid fertilizers: Quantity applied and methods of application, by areas, 1954

| Area | Quantity applied | | | Method of application | | |
|---|---|---|---|---|---|---|
| | Quantity 1/ | Percentage distribution | | By soil injectors - | | By all other methods |
| | | Anhydrous ammonia | All other | By custom applicators | By farmers | |
| | Tons | Percent | Percent | Percent | Percent | Percent |
| Northeast--------- | 4,792 | 30 | 70 | 48 | 45 | 7 |
| Corn Belt--------- | 100,776 | 72 | 28 | 68 | 24 | 8 |
| Lake States------- | 16,029 | 62 | 38 | 70 | 28 | 2 |
| Northern Plains--- | 48,123 | 72 | 28 | 71 | 20 | 9 |
| Appalachian------- | 16,220 | 71 | 29 | 60 | 37 | 3 |
| Southeast--------- | 11,874 | 87 | 13 | 42 | 58 | 2/ |
| Delta States------ | 83,897 | 99 | 1 | 19 | 80 | 1 |
| Southern Plains--- | 32,640 | 85 | 15 | 34 | 33 | 33 |
| West-------------- | 289,470 | 31 | 69 | 44 | 24 | 32 |
| United States--- | 603,821 | 56.4 | 43.6 | 47.3 | 33.2 | 19.5 |

1/ From Soil and Water Conservation Research Division, ARS.
2/ Less than 0.5 percent.

Table 3.- Fertilizer and liming materials: Consumption in the United States, specified years

| Calendar year | All fertilizers 1/ | | | | | Liming materials 2/ |
|---|---|---|---|---|---|---|
| | Quantity | Average nutrient content | | | | |
| | | Nitrogen | Available $P_2O_5$ | $K_2O$ | Total | |
| | 1,000 tons | Percent | Percent | Percent | Percent | 1,000 tons |
| 1850 | 53 | 5.66 | 7.54 | 1.89 | 15.09 | --- |
| 1860 | 164 | 6.10 | 7.32 | 1.83 | 15.25 | --- |
| 1870 | 321 | 4.36 | 9.66 | 1.25 | 15.27 | --- |
| 1880 | 753 | 2.52 | 9.30 | 1.73 | 13.55 | --- |
| 1890 | 1,387 | 2.73 | 9.50 | 2.23 | 14.46 | --- |
| 1900 | 2,678 | 2.27 | 9.01 | 3.17 | 14.45 | --- |
| 1910 | 5,454 | 2.63 | 9.00 | 3.80 | 15.43 | 946 |
| 1920 | 7,176 | 3.12 | 9.05 | 3.53 | 15.70 | 2,653 |
| 1930 | 8,240 | 4.24 | 9.37 | 4.14 | 17.75 | 3,588 |
| 1935 | 6,275 | 4.46 | 9.30 | 4.62 | 18.38 | 3,505 |
| 1940 | 8,336 | 4.54 | 10.75 | 4.86 | 20.15 | 14,406 |
| 1945 | 13,813 | 4.36 | 10.26 | 5.22 | 19.84 | 23,023 |
| 1946 | 15,879 | 4.56 | 10.41 | 5.19 | 20.16 | 29,319 |
| 1947 | 17,057 | 4.66 | 10.29 | 4.96 | 19.91 | 30,010 |
| 1948 | 17,228 | 4.63 | 10.56 | 5.36 | 20.55 | 25,686 |
| 1949 | 17,601 | 4.93 | 10.59 | 5.87 | 21.39 | 27,902 |
| 1950 | 19,316 | 5.52 | 10.60 | 6.08 | 22.20 | 29,842 |
| 1951 | 20,610 | 5.84 | 10.03 | 6.66 | 22.53 | 26,931 |
| 1952 | 21,443 | 6.40 | 9.80 | 7.01 | 23.21 | 26,562 |
| 1953 | 22,247 | 7.16 | 9.84 | 7.57 | 24.57 | 20,600 |
| 1954 | 22,526 | 8.12 | 9.92 | 8.04 | 26.08 | 18,975 |

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1/ Soil and Water Conservation Research Division, Agricultural Research Service. Tonnage of fertilizer is for continental United States; plant nutrient data before 1930 includes fertilizer used in Hawaii and Puerto Rico

2/ From reports of the National Agricultural Limestone Institute Inc. Data for 1910-45 from Historical Statistics, Bureau of the Census, 1789-1945.

nonagricultural use but in most States more than 90 percent of the fertilizer bought was for use on farms.

Along with the annual increase in the tonnage has been a large increase in plant nutrient content of the fertilizer. From 1930 to 1954, the tonnage of fertilizer increased by 175 percent. During this time the tonnage of plant nutrients increased 300 percent (table 4). This increase reflected higher analysis of fertilizer. The important factors in connection with the quantity of plant nutrients consumed in the different areas are the kind of crops grown, the natural productivity of the soil, and the available supply of moisture.

The Southeastern, Appalachian, and Northeastern States together had only 18 percent of the cropland in 1930 but accounted for 75 percent of the consumption of plant nutrients supplied by commercial fertilizers. Crops of high per acre value, such as cotton, tobacco, truck crops and fruit, are grown extensively in these States. Much of the cropland in these areas is low in productivity, and the average supply of moisture is relatively high. In 1954, usage in these State groups amounted to only 44 percent of all plant nutrients supplied by fertilizer. At this time, the Corn Belt consumed 25 percent of all plant nutrients applied in fertilizer. In recent years, this shift has been due largely to increased use of fertilizer on corn. According to the census of agriculture, corn accounted for about a third of the tonnage of fertilizer used on farms in 1954.

Although the percentage increase in the use of commercial fertilizer and plant nutrients from 1930 to 1954 was exceptionally large in many of the Great Plains and Mountain States, the tonnage was still relatively small in 1954.

Because of variation in nutrient content of the fertilizer used and in the acreage of cropland in different States, the quantity of nutrients consumed per unit of cropland provides a measure of the extent of use in the different States. Table 5 shows the quantity of commercial fertilizer and plant nutrients contained therein that was applied per acre of cropland in specified years. The per acre figures are somewhat high because fertilizer used on pasture and that used for nonagricultural purposes is included. However, these uses are small enough in most areas to permit a fairly reasonable picture of the extent of use.

Florida has the highest average use of fertilizer. In this State, 652 pounds of fertilizer and 129 pounds of plant nutrients were applied per acre in 1930. By 1954, use had increased to 1,132 pounds of fertilizer and 232 pounds of plant nutrients. Eleven States used more than 100 pounds of plant nutrients per acre of cropland in 1954. All of these States, except Alabama, were on the Atlantic Coast.

Table 4.- Plant nutrients, primary: Consumption by kinds and by States, specified years 1/

| Area and State | Nitrogen |  |  | Available $P_2O_5$ |  |  | $K_2O$ |  |  | Total |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 |
|  | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons |
| Northeast: |  |  |  |  |  |  |  |  |  |  |  |  |
| Maine | 9,430 | 14,586 | 11,821 | 20,250 | 24,114 | 18,456 | 15,100 | 31,563 | 20,617 | 44,780 | 70,263 | 50,894 |
| New Hampshire | 424 | 1,166 | 1,033 | 1,044 | 3,982 | 1,921 | 620 | 1,878 | 1,647 | 2,088 | 7,026 | 4,601 |
| Vermont | 527 | 1,036 | 1,393 | 1,727 | 8,680 | 7,088 | 1,011 | 2,026 | 5,087 | 3,265 | 11,742 | 13,568 |
| Massachusetts | 3,294 | 4,742 | 5,280 | 5,039 | 9,149 | 7,911 | 3,364 | 6,031 | 6,988 | 11,697 | 19,922 | 20,179 |
| Rhode Island | 322 | 853 | 878 | 725 | 2,016 | 1,435 | 446 | 1,370 | 1,387 | 1,493 | 4,239 | 3,700 |
| Connecticut | 3,250 | 4,712 | 5,120 | 6,000 | 7,806 | 7,410 | 3,981 | 5,507 | 7,537 | 13,231 | 18,025 | 20,067 |
| New York | 10,800 | 21,638 | 38,045 | 32,141 | 74,636 | 67,808 | 12,845 | 29,813 | 48,271 | 55,786 | 126,087 | 154,124 |
| New Jersey | 5,100 | 11,592 | 16,738 | 15,707 | 27,564 | 28,798 | 10,795 | 20,821 | 27,148 | 31,602 | 59,977 | 72,684 |
| Pennsylvania | 6,458 | 15,141 | 34,152 | 39,411 | 65,405 | 83,548 | 15,698 | 30,780 | 66,942 | 61,567 | 111,326 | 184,642 |
| Delaware | 950 | 1,609 | 5,983 | 3,922 | 5,346 | 10,017 | 2,159 | 3,907 | 10,294 | 7,031 | 10,862 | 26,294 |
| Maryland | 4,358 | 8,145 | 15,146 | 16,975 | 25,614 | 34,279 | 9,514 | 15,576 | 28,725 | 30,847 | 49,335 | 78,150 |
| Total | 44,913 | 85,220 | 135,589 | 142,941 | 254,312 | 268,671 | 75,533 | 149,272 | 224,643 | 263,387 | 488,804 | 628,903 |
| Corn Belt: |  |  |  |  |  |  |  |  |  |  |  |  |
| Ohio | 6,004 | 17,760 | 53,698 | 43,233 | 80,894 | 134,529 | 13,188 | 46,239 | 129,460 | 62,425 | 144,893 | 317,687 |
| Indiana | 4,337 | 10,434 | 72,672 | 30,383 | 63,252 | 148,102 | 15,546 | 48,035 | 162,461 | 50,266 | 121,721 | 383,235 |
| Illinois | 865 | 4,725 | 77,455 | 5,284 | 38,640 | 122,125 | 2,798 | 21,908 | 148,364 | 8,947 | 65,273 | 347,944 |
| Iowa | 450 | 1,610 | 71,945 | 3,090 | 27,855 | 100,187 | 1,700 | 8,246 | 46,371 | 5,240 | 37,711 | 218,503 |
| Missouri | 734 | 2,540 | 77,637 | 7,958 | 27,932 | 86,242 | 875 | 6,870 | 69,929 | 9,567 | 37,342 | 233,808 |
| Total | 12,390 | 37,069 | 353,407 | 89,948 | 238,573 | 591,185 | 34,107 | 131,298 | 556,585 | 136,445 | 406,940 | 1,501,177 |
| Lake States: |  |  |  |  |  |  |  |  |  |  |  |  |
| Michigan | 3,800 | 8,536 | 31,670 | 17,800 | 44,841 | 81,896 | 8,135 | 26,647 | 78,722 | 29,735 | 80,024 | 192,288 |
| Wisconsin | 1,122 | 8,629 | 20,116 | 7,206 | 33,575 | 61,048 | 4,435 | 24,470 | 73,019 | 12,763 | 66,674 | 154,183 |
| Minnesota | 308 | 1,669 | 24,128 | 2,997 | 22,036 | 65,562 | 1,044 | 6,626 | 37,212 | 4,349 | 30,331 | 126,902 |
| Total | 5,230 | 18,834 | 75,914 | 28,003 | 100,452 | 208,506 | 13,614 | 57,743 | 188,953 | 46,847 | 177,029 | 473,373 |
| Northern Plains: |  |  |  |  |  |  |  |  |  |  |  |  |
| North Dakota | 2/ | 132 | 3,001 | 600 | 1,362 | 16,453 | 2/ | 566 | 1,093 | 600 | 2,060 | 20,547 |
| South Dakota | 2/ | 6 | 4,551 | 65 | 128 | 6,589 | 2/ | 19 | 207 | 65 | 153 | 11,347 |
| Nebraska | 5 | 385 | 51,765 | 336 | 774 | 25,270 | 5 | 4 | 1,709 | 346 | 1,163 | 78,744 |
| Kansas | 93 | 341 | 37,185 | 856 | 9,718 | 44,273 | 55 | 575 | 4,271 | 1,004 | 10,634 | 85,729 |
| Total | 98 | 864 | 96,502 | 1,857 | 11,982 | 92,585 | 60 | 1,164 | 7,280 | 2,015 | 14,010 | 196,367 |
| Appalachian: |  |  |  |  |  |  |  |  |  |  |  |  |
| West Virginia | 868 | 1,870 | 3,565 | 5,458 | 10,862 | 8,746 | 1,750 | 2,698 | 6,249 | 8,076 | 15,430 | 18,560 |
| Kentucky | 3,226 | 8,512 | 31,097 | 12,892 | 50,139 | 66,951 | 6,076 | 11,704 | 60,069 | 22,194 | 70,355 | 158,117 |
| Tennessee | 2,655 | 11,524 | 42,357 | 18,603 | 51,971 | 59,656 | 4,393 | 13,921 | 53,215 | 25,651 | 77,416 | 155,228 |
| Virginia | 15,904 | 20,532 | 37,668 | 40,606 | 73,942 | 77,672 | 18,100 | 28,688 | 72,363 | 74,610 | 123,162 | 187,703 |
| North Carolina | 62,580 | 73,195 | 116,191 | 90,704 | 124,426 | 148,319 | 38,834 | 79,897 | 136,238 | 192,118 | 277,518 | 400,748 |
| Total | 85,233 | 115,633 | 230,878 | 168,263 | 311,340 | 361,344 | 69,153 | 136,908 | 328,134 | 322,649 | 563,881 | 920,356 |

See footnotes at end of table.

- Continued

Table 4.- Plant nutrients, primary: Consumption by kinds and by States, specified years. 1/- Continued

| Area and State | Nitrogen | | | Available $P_2O_5$ | | | $K_2O$ | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 |
| | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons | Tons |
| Southeast: | | | | | | | | | | | | |
| South Carolina--- | 39,897 | 47,120 | 67,594 | 72,581 | 65,336 | 70,213 | 26,148 | 43,893 | 68,544 | 138,626 | 156,349 | 206,351 |
| Georgia---------- | 44,623 | 52,385 | 91,102 | 82,460 | 97,324 | 113,506 | 38,030 | 50,224 | 109,512 | 165,113 | 199,933 | 314,120 |
| Florida---------- | 28,888 | 37,871 | 76,495 | 37,331 | 55,733 | 78,995 | 30,783 | 57,795 | 92,875 | 97,002 | 151,399 | 248,365 |
| Alabama---------- | 29,135 | 43,868 | 89,705 | 60,046 | 86,047 | 107,016 | 25,258 | 30,721 | 76,653 | 114,439 | 160,636 | 273,374 |
| Total---------- | 142,543 | 181,244 | 324,896 | 252,418 | 304,440 | 369,730 | 120,219 | 182,633 | 347,584 | 515,180 | 668,317 | 1,042,210 |
| Delta States: | | | | | | | | | | | | |
| Mississippi------ | 18,571 | 38,492 | 114,323 | 29,673 | 40,570 | 47,212 | 9,568 | 14,716 | 38,100 | 57,812 | 93,778 | 199,635 |
| Louisiana-------- | 12,342 | 17,036 | 49,580 | 18,802 | 20,175 | 26,111 | 5,074 | 6,594 | 20,341 | 36,218 | 43,805 | 96,032 |
| Arkansas--------- | 3,012 | 8,920 | 56,206 | 6,528 | 13,863 | 28,790 | 2,681 | 9,417 | 41,936 | 12,221 | 32,200 | 126,932 |
| Total---------- | 33,925 | 64,448 | 220,109 | 55,003 | 74,608 | 102,113 | 17,323 | 30,727 | 100,377 | 106,251 | 169,783 | 422,599 |
| Southern Plains: | | | | | | | | | | | | |
| Oklahoma--------- | 232 | 602 | 11,276 | 728 | 3,221 | 21,149 | 397 | 589 | 5,045 | 1,357 | 4,412 | 37,470 |
| Texas------------ | 5,425 | 15,031 | 73,163 | 15,559 | 33,835 | 75,797 | 4,967 | 7,044 | 22,150 | 25,951 | 55,910 | 171,110 |
| Total---------- | 5,657 | 15,633 | 84,439 | 16,287 | 37,056 | 96,946 | 5,364 | 7,633 | 27,195 | 27,308 | 60,322 | 208,580 |
| Mountain: | | | | | | | | | | | | |
| Montana---------- | 1 | 207 | 2,037 | 559 | 3,238 | 6,851 | 1 | 4 | 49 | 561 | 3,449 | 8,937 |
| Idaho------------ | 15 | 1,563 | 14,568 | 718 | 7,730 | 12,339 | 5 | 597 | 199 | 738 | 9,890 | 27,106 |
| Wyoming---------- | 2/ | 9 | 1,288 | 150 | 1,172 | 2,265 | 2/ | 1 | 44 | 150 | 1,182 | 3,597 |
| Colorado--------- | 28 | 941 | 8,051 | 457 | 4,665 | 10,709 | 8 | 230 | 788 | 493 | 5,836 | 19,548 |
| New Mexico------- | 10 | 335 | 4,497 | 576 | 3,214 | 4,850 | 2 | 66 | 61 | 588 | 3,615 | 9,408 |
| Arizona---------- | 276 | 3,035 | 33,746 | 500 | 3,643 | 12,845 | 20 | 258 | 1,065 | 796 | 6,936 | 47,656 |
| Utah------------- | 2/ | 281 | 3,545 | 368 | 2,480 | 3,669 | 2/ | 47 | 139 | 368 | 2,808 | 7,353 |
| Nevada----------- | 4 | 39 | 325 | 10 | 77 | 422 | 3 | 15 | 39 | 17 | 131 | 786 |
| Total---------- | 334 | 6,410 | 68,057 | 3,338 | 26,219 | 53,950 | 39 | 1,218 | 2,384 | 3,711 | 33,847 | 124,391 |
| Pacific: | | | | | | | | | | | | |
| Washington------- | 1,100 | 5,869 | 40,227 | 1,763 | 9,981 | 12,917 | 1,453 | 2,960 | 4,434 | 4,316 | 18,810 | 57,578 |
| Oregon----------- | 639 | 3,776 | 26,218 | 1,125 | 6,976 | 11,465 | 705 | 1,875 | 2,950 | 2,469 | 12,627 | 40,633 |
| California------- | 16,938 | 67,449 | 172,067 | 11,174 | 45,140 | 64,155 | 3,589 | 18,209 | 20,156 | 31,701 | 130,798 | 256,378 |
| Total---------- | 18,677 | 77,094 | 238,512 | 14,062 | 62,097 | 88,537 | 5,747 | 23,044 | 27,540 | 38,486 | 162,235 | 354,589 |
| United States | 349,000 | 602,449 | 1,828,303 | 772,120 | 1,421,079 | 2,233,567 | 341,159 | 721,640 | 1,810,675 | 1,462,279 | 2,745,168 | 5,872,545 |

1/ From data developed by the Soil and Water Conservation Research Division, ARS.
2/ Less than 0.5 tons.

Table 5.- Fertilizer and plant nutrients: Quantity used per acre of cropland, by States, specified years 1/

| Area and State | Fertilizer | | | Plant nutrients | | |
|---|---|---|---|---|---|---|
| | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 |
| | Pounds | Pounds | Pounds | Pounds | Pounds | Pounds |
| Northeast: | | | | | | |
| Maine | 299 | 364 | 421 | 68 | 106 | 124 |
| New Hampshire | 62 | 131 | 128 | 11 | 32 | 36 |
| Vermont | 30 | 85 | 110 | 6 | 20 | 33 |
| Massachusetts | 277 | 316 | 505 | 48 | 68 | 118 |
| Rhode Island | 281 | 571 | 843 | 52 | 135 | 206 |
| Connecticut | 307 | 417 | 615 | 69 | 83 | 137 |
| New York | 79 | 157 | 215 | 16 | 36 | 55 |
| New Jersey | 391 | 531 | 707 | 79 | 129 | 180 |
| Pennsylvania | 99 | 146 | 250 | 18 | 33 | 66 |
| Delaware | 207 | 217 | 448 | 34 | 50 | 124 |
| Maryland | 202 | 250 | 394 | 35 | 36 | 99 |
| Total | 131 | 199 | 292 | 26 | 47 | 76 |
| Corn Belt: | | | | | | |
| Ohio | 63 | 117 | 199 | 12 | 27 | 60 |
| Indiana | 42 | 95 | 201 | 10 | 22 | 67 |
| Illinois | 7 | 63 | 131 | 1 | 6 | 33 |
| Iowa | 2 | 15 | 55 | 2/ | 3 | 19 |
| Missouri | 9 | 26 | 115 | 1 | 6 | 35 |
| Total | 18 | 55 | 126 | 4 | 10 | 38 |
| Lake States: | | | | | | |
| Michigan | 37 | 79 | 155 | 7 | 19 | 49 |
| Wisconsin | 10 | 50 | 89 | 3 | 13 | 31 |
| Minnesota | 2 | 13 | 32 | 2/ | 3 | 13 |
| Total | 12 | 37 | 73 | 3 | 9 | 25 |
| Northern Plains: | | | | | | |
| North Dakota | 2/ | 1 | 4 | 2/ | 2/ | 2 |
| South Dakota | 2/ | 2/ | 3 | 2/ | 2/ | 1 |
| Nebraska | 2/ | 2/ | 20 | 2/ | 2/ | 8 |
| Kansas | 2/ | 3 | 20 | 2/ | 1 | 7 |
| Total | 2/ | 1 | 12 | 2/ | 2/ | 5 |
| Appalachian: | | | | | | |
| West Virginia | 52 | 96 | 135 | 10 | 21 | 34 |
| Kentucky | 42 | 129 | 244 | 8 | 26 | 66 |
| Tennessee | 52 | 125 | 224 | 2 | 26 | 61 |
| Virginia | 221 | 314 | 493 | 37 | 62 | 116 |
| North Carolina | 418 | 483 | 636 | 65 | 90 | 137 |
| Total | 172 | 253 | 388 | 28 | 49 | 92 |

See footnotes at end of table.

- Continued

Table 5.- Fertilizer and plant nutrients: Quantity used per acre of cropland, by States, specified years 1/- Con.

| Area and State | Fertilizer |  |  | Plant nutrients |  |  |
|---|---|---|---|---|---|---|
|  | 1930 | 1945 | 1954 | 1930 | 1945 | 1954 |
|  | Pounds | Pounds | Pounds | Pounds | Pounds | Pounds |
| Southeast: |  |  |  |  |  |  |
| South Carolina--- | 354 | 378 | 499 | 65 | 75 | 111 |
| Georgia---------- | 219 | 262 | 415 | 39 | 51 | 94 |
| Florida---------- | 652 | 892 | 1,132 | 129 | 165 | 232 |
| Alabama---------- | 177 | 269 | 494 | 31 | 52 | 107 |
| Total---------- | 262 | 346 | 542 | 48 | 66 | 118 |
| Delta States: |  |  |  |  |  |  |
| Mississippi------ | 120 | 149 | 255 | 17 | 28 | 68 |
| Louisiana-------- | 34 | 128 | 208 | 17 | 24 | 61 |
| Arkansas--------- | 46 | 46 | 132 | 4 | 11 | 43 |
| Total---------- | 83 | 106 | 196 | 12 | 21 | 57 |
| Southern Plains: |  |  |  |  |  |  |
| Oklahoma--------- | 1 | 4 | 23 | 2/ | 1 | 7 |
| Texas------------ | 9 | 20 | 42 | 2/ | 4 | 12 |
| Total---------- | 6 | 14 | 37 | 1 | 3 | 11 |
| Mountain: |  |  |  |  |  |  |
| Montana---------- | 2/ | 2 | 5 | 2/ | 1 | 2 |
| Idaho------------ | 1 | 24 | 47 | 2/ | 6 | 14 |
| Wyoming---------- | 2/ | 4 | 11 | 2/ | 1 | 4 |
| Colorado--------- | 2/ | 6 | 14 | 2/ | 2 | 6 |
| New Mexico------- | 3 | 11 | 32 | 1 | 3 | 12 |
| Arizona---------- | 16 | 116 | 304 | 3 | 21 | 86 |
| Utah------------- | 2 | 14 | 36 | 1 | 4 | 12 |
| Nevada----------- | 2/ | 2 | 41 | 2/ | 1 | 4 |
| Total---------- | 1 | 11 | 30 | 2/ | 3 | 10 |
| Pacific: |  |  |  |  |  |  |
| Washington------- | 11 | 38 | 91 | 2 | 9 | 26 |
| Oregon----------- | 8 | 32 | 90 | 2 | 8 | 25 |
| California------- | 61 | 254 | 375 | 9 | 34 | 60 |
| Total---------- | 35 | 145 | 241 | 6 | 21 | 43 |
| United States | 44 | 76 | 128 | 8 | 15 | 33 |

1/ Acreage of cropland includes cropland harvested and crop failure as reported by the 1930 and 1945 Census of Agriculture. For 1954, estimates of cropland harvested and crop failure were made by the Farm Economics Research Division, ARS, based on information available from the 1954 Census of Agriculture and from the Agricultural Estimates Division, AMS.

2/ Less than 0.5 pounds.

Reports of the census of agriculture show that amounts spent for commercial fertilizer vary widely in the different States. The size of the State and the acreage of cropland, together with the climate and kinds of crops grown, influence this expenditure.

In 1954, farmers in each of 11 States, North Carolina, California, Indiana, Illinois, Georgia, Ohio, Florida, Iowa, Missouri, Mississippi, and Alabama, spent more than $40 million for fertilizer (fig. 1). North Carolina and California were high among the States, with $70 million and $63 million, respectively. In the Northern Plains and Mountain States, only Nebraska, Kansas, and Arizona had expenditures of more than $10 million.

## LIMING MATERIALS

The job of applying liming materials is done largely by custom operators. In 1954, they applied 85 percent of the total tonnage of liming materials used on farms in the United States (table 6). The remaining tonnage was applied by the farmers with their own, borrowed, or exchange equipment.

In the Corn Belt, about 93 percent of the liming materials was applied by custom operators and in the Delta States more than 90 percent was so applied. Custom operators spread about 95 percent of the quantity used in the Northern Plains but in these States total consumption was relatively low.

In some other areas where consumption was low, farmers themselves applied a high percentage of the liming materials. They applied 70 percent of the tonnage in the New England States and more than 50 percent in West Virginia and North Carolina.

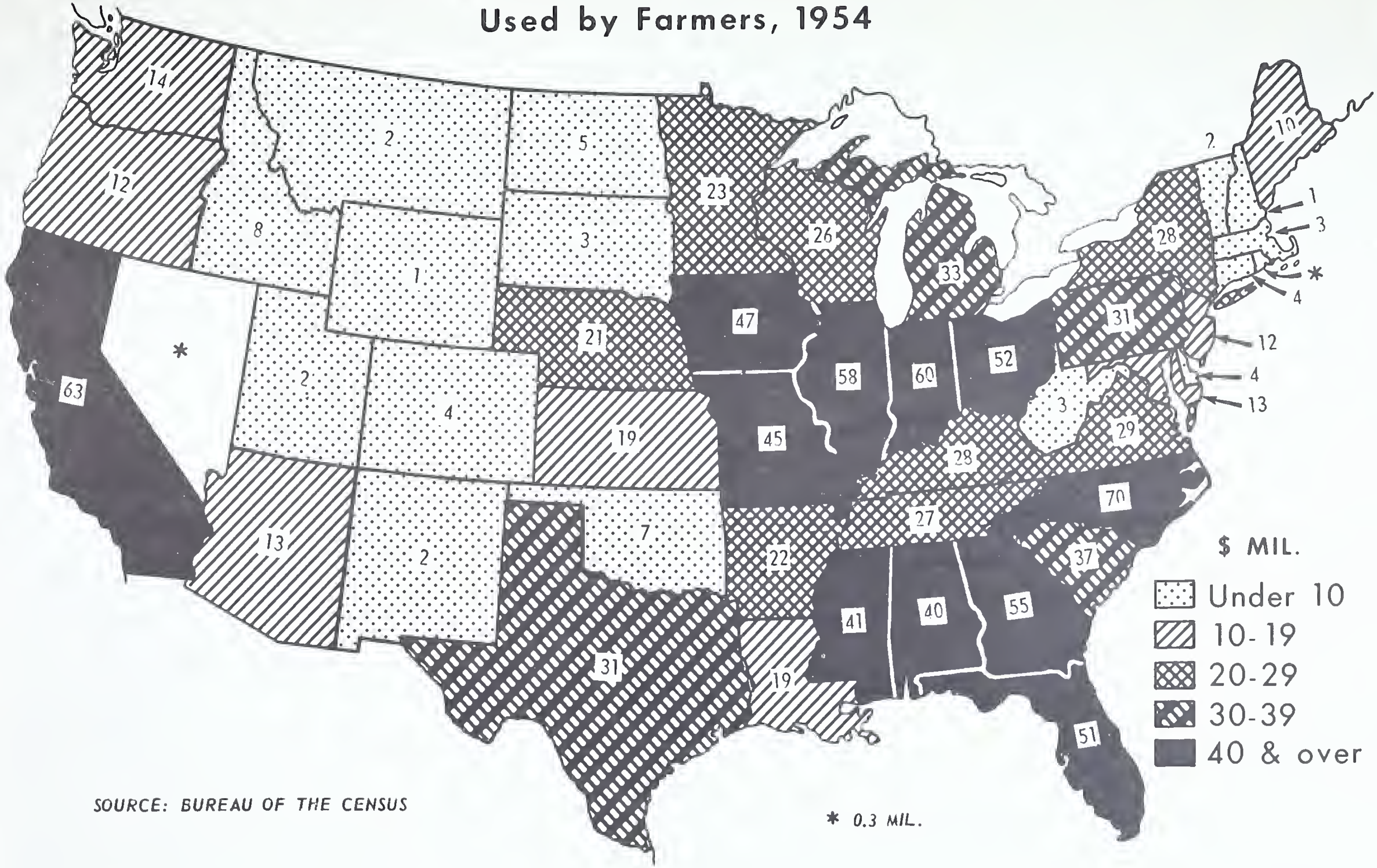
Several different materials were used for agricultural liming purposes in 1954, but ground limestone accounted for about 95 percent of the total quantity used. The tonnage of all other materials is on the basis of ground limestone equivalent.

Relatively small quantities of liming materials were used on farms in the United States before the inception of the Agricultural Conservation Program in 1936 (table 3). Annual consumption increased rapidly after this until 1947, when 30 million tons were used. Since 1947 the use of liming materials has declined sharply. In 1954, less than 20 million tons were applied to our agricultural land.

States in the Corn Belt, Wisconsin, and Kentucky, each used more than a million tons. These 7 States used about two-thirds of the total tonnage used (table 6). The Corn Belt alone accounted for 50 percent of the tonnage. The use of liming materials here was 4 times that in the Appalachian States, the next group in importance. Illinois with 2.7 million tons used more liming materials in 1954 than any other State or State group other than the Corn Belt.

## COMMERCIAL FERTILIZER

### Used by Farmers, 1954



SOURCE: BUREAU OF THE CENSUS

* 0.3 MIL.

U. S. DEPARTMENT OF AGRICULTURE

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Figure 1

Table 6.- Liming materials: Quantity applied and method of application, by States and areas, 1954

| Area and State 1/ | Total 2/ | Percentage applied - | |
|---|---|---|---|
| | | By custom operators | By farmers |
| | 1,000 tons | Percent | Percent |
| Northeast: | | | |
| New England States | 202 | 30 | 70 |
| New York | 633 | 78 | 22 |
| New Jersey | 160 | 68 | 32 |
| Pennsylvania | 839 | 70 | 30 |
| Delaware and Maryland | 337 | 80 | 20 |
| Total | 2,171 | 70 | 30 |
| Corn Belt: | | | |
| Ohio | 1,949 | 82 | 18 |
| Indiana | 1,813 | 95 | 5 |
| Illinois | 2,615 | 93 | 7 |
| Iowa | 1,665 | 98 | 2 |
| Missouri | 1,990 | 97 | 3 |
| Total | 10,032 | 93 | 7 |
| Lake States: | | | |
| Michigan | 317 | 72 | 28 |
| Wisconsin | 1,133 | 73 | 27 |
| Minnesota | 409 | 82 | 18 |
| Total | 1,859 | 75 | 25 |
| Northern Plains: | | | |
| Nebraska | 256 | 94 | 6 |
| Kansas | 428 | 96 | 4 |
| Total | 684 | 95 | 5 |
| Appalachian: | | | |
| West Virginia | 172 | 40 | 60 |
| Kentucky | 1,121 | 80 | 20 |
| Tennessee | 228 | 82 | 18 |
| Virginia | 603 | 70 | 30 |
| North Carolina | 367 | 42 | 58 |
| Total | 2,491 | 69 | 31 |
| Southeast: | | | |
| South Carolina | 136 | 66 | 34 |
| Georgia | 312 | 90 | 10 |
| Florida | 452 | 70 | 30 |
| Alabama | 203 | 85 | 15 |
| Total | 1,103 | 78 | 22 |
| Delta States: | | | |
| Mississippi | 171 | 88 | 12 |
| Louisiana | 83 | 88 | 12 |
| Arkansas | 193 | 95 | 5 |
| Total | 447 | 91 | 9 |
| Southern Plains | 108 | 86 | 14 |
| Pacific | 77 | 67 | 33 |
| United States | 18,975 | 84 | 16 |

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1/ States not listed use little or no liming materials. The total for the United States includes 3,000 tons which is not listed.

2/ From reports of The National Agricultural Limestone Institute, Inc.

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